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### MATTER OF MEN KINDS OF STLICATE MATERIALS

#### CH BASES OF SILION CREATIC COMPOUNDS

A. P. Krechkov Submitted by Asad D. S. Belyankin

on the organic compounds of silicon are now being t the action of corrosive agents, possess excellent and high dislectric constants, are water- and heat-cly, they are widely used in various technical fields

of these materila is based on milicio acid esters and substitution products mixed with the alrony-, amino-, in of mildes, etc.

our to subjected to exponification, heat transformation, ence of silerane groups of silicon and oxygen atoms:

The process of formation of high-molecular silicon organic compounds, manuals, from orthogilicic acid esters, may be represented as follows (6):

 $- \frac{n}{2} \mathbb{E}_{2}0 \rightarrow \frac{n}{2} \mathbb{B}1(0CH_{\overline{2}})_{\downarrow}.$ 

1 81(OCE3)30E + 1 CE30E;

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# 2. (CH<sub>3</sub>0)<sub>3</sub>810; H+H0 81(OCH<sub>3</sub>)<sub>3</sub> -> → (CE30)381081(OCH3)3+H20 or $\frac{n}{2}$ 81(OCH<sub>3</sub>)<sub>3</sub>OH $\rightarrow \frac{n}{2}$ (CH<sub>3</sub>O)<sub>3</sub>S1OS1(OCH<sub>3</sub>)<sub>3</sub>+ $\frac{n}{2}$ H<sub>2</sub>O; n 81 (OCH<sub>3</sub>)4 + n H<sub>2</sub> H<sub>2</sub>0 + n S1(OCH<sub>3</sub>)4 + n 81(0CH3)3CH + n CH3OH; $\frac{n}{h}$ 81(0CH<sub>3</sub>)<sub>3</sub>OH $\rightarrow \frac{n}{H}$ (CH<sub>3</sub>O)<sub>3</sub>S1OS1(0CH<sub>3</sub>)<sub>3</sub> + $\frac{n}{8}$ H<sub>2</sub>O etc; $\frac{1}{2}$ (CH<sub>3</sub>0)<sub>3</sub>81081(OCH<sub>3</sub>)<sub>3</sub> + $\frac{1}{2}$ H<sub>2</sub>0 $\rightarrow$ $\frac{1}{2}$ (CH<sub>3</sub>0)<sub>5</sub>81<sub>2</sub>0(OH) + $\frac{1}{2}$ CH<sub>3</sub>OH, m (CH<sub>3</sub>O)<sub>3</sub>S1<sub>2</sub>O(OH) → m S1<sub>4</sub>O<sub>3</sub>(OCH<sub>3</sub>)<sub>1O</sub> + m H<sub>2</sub>O etc. The resultant products are: $(OH_3O)_3SiO_8iO(OCH_3)_27_nSi(OCH_3)_3 + 2nCH_3OH$ , i.e., the reaction consists of alternate seponification and condensation. relation between the degree of condensation of an ester p and the num-er presentation of vater m acting on a gram-molecule of the ester is ex-mal by the following formula: is is the number of gran-polecules of the original ester. Morrise row alkyl- or aryl-substitution halogen silenes, the formation of molymidele compounds can be represented as follows: R(Ar)Cl Grigard's reaction Silicon-halogen derivatives R2(Ar)281012 R<sub>3</sub>(Ar)<sub>3</sub>81Cl -Trialkyl- or tri-Dialkyl- or diaryl-dicklerellane ary!monochlorsilane Baponification $R_2(Ar)_2B1(OE)_2$ RzArz81(OH) Bilandiols Silanola emmetion of siles es into milozames R(Ar) R(Ar) R(Ar) - \$1-0-\$1-R(Ar) B(Ar) H(Ar) Disiloranes where R and Ar may be bivalent radicula.

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In addition to open chain compounds, products whose structure is syclic are also obtained.

Siloxane chains are very strong. The expenditure of considerable energy is required to break the link between the silicon and oxygen atoms. The energy of combination of oxygen with silicon is 89.3 kilocalories per grammolecule; the energy of combination of oxygen atoms with each other is 58.6 kilocalories per gram-molecule, which is only 2/3 of the energy of combination of oxygen with silicon.

The great resistance of silicon organic compounds to the action of heat is due to this. Thus, their exceptional thermal stability, immunity to moisture and many chemical reagents, and excellent dielectric figures are due to the fact that the sheletons of silicon organic compounds are constructed of silicon and oxygen atoms, similar to quartz, glass, and mineral silicates. They are, therefore, synthetic substitutes for fiber glass, asbestos, and mics, compared with which they are excellent artificial materials, resistant to moisture and high temperatures.

However, should the thermal treatment exceed the permissible temperature limit for organic compounds, the organic portion of the high-molecular silicon organic compounds running throughout the highly dispersed basic mineral material undergoes further chemical transformation, connected with an increase in the value of the coefficient of polymerization n.

Therefore, the alternate processes of saponification, condensation, and thermal decomposition at high temperatures ultimately (if the basic material is a nonsubstituted ester) result in the formation of a polymer whose composition approximates (810<sub>2</sub>)n.

For reasons already given, the physical and chemical properties of highreliefular products obtained from metabolecular silicon organic compounds approximate those of strongly dehydrated polysilicic acids and their salts.

The high-molecular cilicon organic compounds thus obtained form a crystalline lettice consisting of priccules forming a chain of elementary nucloi of silicon states surrounded by four oxygen atoms disposed at equal distances (1.55 Augstress Units) from each other on the peaks of an almost perfect tetrahadron.

A lattice frame of this type, formed of silicon and oxygen atoms, resembles the steal structure of a skyecraper, where the intervals between the metal structures are filled with bricks, blocks, tiles, and other building material.

In the construction of termic materials of this type, for example, the intervals in the silicon organic shell between the tetrahedral nuclei of silicon and oxygen atoms are filled by other molecules, e.g., by the hexagonal insidedral rhambeneras of aluminum oxide. As a result, very stable plastic masses, characterized by high mechanical, electrical and other physical properties thich snable the finished product to withstand severe working consistions, are formed. The filler, which does not react with silicon organic confidence, is commissed at moderate temperatures as a viscous, resilient plastic surrounding the silicon organic polymer.

To this is due the value of the silicon organic compounds used in the manufacture of cement, refractory materials, special ceramics, etc.

Another important use is due to the fast that the following processes occur when high-molecular silicon organic compounds are subjected to the action of heat:

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1. Surface solution of the filler in the binding silicon organic polymer under high-temperature conditions. As a result, a solid solution may be formed, characterized by maximum structural density and high mechanical strength.

2. Formation of chemically active centers around the silicon atoms, characterized by the presence of free units of chemical affinity at the moment the organic radicals are separated from them. This brings about an increase of the tendency for chemical combination with the active molecules of the secondary ingredients, joint crystallization, and the appearances of intensified adsorption.

This suggests the feasibility of using active types of chemical compounds as rew material, capable not only of serving as unusual fillers for the intramolecular spaces of silicon organic polymers or the products of their complete
thermal decomposition (silicon-oxygen lattices), but of combining chemically
with the active centers of the silicon polymers, when it is desirable to facilitate the acceleration of the reaction of the basic liquid phase (the silicon
organic compounds) with the solid phase (metallic oxides, etc.).

The production of high-quality silicate materials from silicon organic compounds envisages the preliminary attainment of high dispersion in the basic material and the employment of guaranteed methods for investigating their dispersion, specific surfaces of the particles, adsorption properties, recrystallization phenomena, coclusion, placticity, etc.

The introduction of the necessary amount of liquid high-molecular silicon organic compound into the solid mass of dispersed substance lowers the degree of interconstituent friction, peptizes the filler particles, and facilitates their free migration. It is thus possible to achieve tighter packing.

After firing the mass obtained by the above method, the crystallization as restrict for religing the high degree of strength and uniformity which gives the finithed articles their high quality is schieved.

Thus, for example, the slay which is the carrier of plastic properties and the binder of the usual ceremic massed makes way for a high-molecular silicen organic compound which has a substantial effect on the quality of the product during its shaping and a because firing. This is all the more important because in many cases materials containing clay are unstable and unsatitable, e.g., for the specific working conditions of the ceremic products.

By using silicen organic Compounds and special chemical technology methods, substances can be obtained from which the finished product can be shiped by my methods pouring, squeezing the paste through nozzles of various threes, prefer pressing, centrifugal casting, machining the half-finished material with outters, etc.

Our experimental investigations confirm the above theoretical position. The real persons interials prepared by us, in contrast to the ordinary multicomponent systems, are two-component systems, in which one phase, the silicon organic compound, is liquid and the other, a refractory metallic exide, is

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